Chapter RV

A REVIEW OF PREVIOUS USGS WORLD ENERGY ASSESSMENTS[1]

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in U.S. Geological Survey Digital Data Series 60

[1]This material was first presented as part of USGS Fact Sheet FS-145-97 (October, 1997), entitled “Changing perceptions of world oil and gas resources as shown by recent USGS petroleum assessments”.

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INTRODUCTION

The U.S. Geological Survey (USGS) periodically conducts geology-based assessments of the oil and gas resources of the world, in recognition of the fact that United States economic security is closely linked to energy resources outside the United States. Four such petroleum assessments have been published in recent years (Masters and others, 1984, 1987, 1991, and 1994). A summary of these assessments (table 1), which include the United States, indicates the magnitude of world conventional oil and gas resources, as perceived in the 1980's and 1990's by the USGS, prior to the New Millennium Assessment that is reported in this CD-ROM.

The four successive world petroleum assessments done prior to the New Millennium Assessment evidence changes in perception through time. The assessments were prepared by the same core group of geologists, using a consistent methodology. Because of this continuity, differences among the four assessments can be largely attributed to an evolving understanding of world recoverable oil and gas resources, rather than to procedural or philosophical changes. In this review, some of the trends in the resource estimates of table 1 are examined, with a view toward developing a historical context in which to place the results of the USGS New Millennium World Petroleum Assessment.

MOST OF THE WORLD'S OIL SUPPLY WAS VIEWED AS RESIDING IN ACCUMULATIONS ALREADY DISCOVERED

USGS estimates of world undiscovered conventional oil resources changed relatively little from January 1, 1981, to January 1, 1993 (fig. RV-1). In contrast, estimates of world identified (discovered) oil reserves increased during this 12-year period by a total of 379 billion barrels of oil (BBO). This increase occurred despite declining exploration success (Masters and others, 1994, fig. 6) (exploration success converts undiscovered resources to identified reserves) and removal from identified reserves through production of 254 BBO (table RV-1). Thus, past USGS assessments indicate that the bulk of conventional oil yet to be produced in the world resides in fields that have already been discovered (fig. RV-1).

The trend of increasing estimates of identified oil reserves with each successive assessment (fig. RV-1) is interpreted here to indicate that future reserve growth of discovered oil fields has been chronically under assessed.

WORLD GAS RESOURCES WERE VIEWED AS LESS EXPLOITED THAN THOSE OF OIL

USGS estimates of world undiscovered conventional natural-gas resources increased from January 1, 1985, to January 1, 1993, as did estimates of world identified (discovered) natural-gas reserves (fig. RV-2). The ratio of discovered to undiscovered

gas resources was slightly greater than 1.0 in the 1993 assessment (fig. RV-2). In contrast, discovered reserves of oil already exceeded undiscovered oil resources in the estimates of the 1981 assessment (fig. RV-1).

The proportion of undiscovered to discovered resources is higher for gas than for oil (figs. RV-1, RV-2), implying that the overall exploitation of world natural-gas resources lags that of oil, perhaps by several decades. Past USGS assessments indicate that a significant fraction of the conventional natural gas yet to be produced in the world will come from fields that are not yet discovered (fig. RV-2).

TOTAL WORLD RESOURCES OF CONVENTIONAL OIL AND GAS WERE VIEWED AS APPROXIMATELY EQUAL

On an energy-equivalent basis, substantially more oil than gas has been produced in the world (fig. RV-3). Does this primarily reflect the more vigorous exploitation of oil resources or is the world endowment of recoverable oil in conventional fields much greater than that of gas?

Three successive USGS world petroleum assessments concluded that world future resources (discovered reserves plus undiscovered resources) of conventional oil and gas are approximately equal on an energy-equivalent basis (fig. RV-4). In the United States, which is heavily explored and where gas generally finds a ready market, cumulative oil production is only 1.2 times greater than cumulative gas production on an energy-equivalent basis (Masters and others, 1994). The USGS domestic petroleum assessment (U.S. Geological Survey National Oil and Gas Resource Assessment Team, 1995) done in 1995 independently of USGS world assessments predicted approximately equal future resources of conventional oil and natural gas in the United States.

Thus, past world and domestic USGS assessments suggest that total world resources of oil and gas do not differ from one another nearly so much as cumulative production data (fig. RV-3) might suggest.

PERCEPTIONS OF THE WORLD PETROLEUM RESOURCE BASE INCREASED THROUGH TIME

USGS estimates of world total recoverable resources (cumulative production, identified (discovered) reserves, and undiscovered resources) for conventional oil plus natural gas increased by 910 billion barrels of oil and oil equivalent in the 8-year span from January 1, 1985, to January 1, 1993 (fig. RV-5). The amount of world "ultimate" oil and gas resources has not been seen by past USGS assessments as a fixed, absolute quantity, but rather as a time-dependent volume that increased as perception limits receded.

Upward revisions in petroleum resource forecasts have not been unique to the USGS. Estimates of total resource limits, in general, have regularly increased (Adelman and Lynch, 1997). If world recoverable petroleum resources are envisioned as forming a continuum extending from high- to low-quality accumulations, the argument could be made that as of 1993 the end of this continuum was not yet in sight.

A FINAL COMMENT

Oil and gas resource assessments that are firmly grounded by data serve a valuable purpose. As summarized by Masters (1993), such assessments present a numerical hypothesis – the where and when – for petroleum-resource conditions of the earth as perceived at a particular point in time. Quantitative assessments facilitate recognition of the big picture, which is necessary for purposes of planning and investment, and also form the foundation for periodic adjustments to the big picture (such as provided by the USGS New Millennium World Petroleum Assessment) made necessary by changes in technology and scientific understanding.

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Table RV-1. Summary of previous U.S. Geological Survey world petroleum assessments (which include the United States).

[Data are from Masters and others, 1984, 1987, 1991, and 1994. BBO, billion barrels of oil; BBOE, billion barrels of oil equivalent. A gas volume is expressed as its energy equivalent in barrels of oil by assuming that 6,000 cubic feet of gas equals 1 barrel of oil. Identified reserves (category 2) include the projected reserve growth of known fields. Dash (-) indicates no data.]

CATEGORY	OIL (BBO) Effective Date of Assessment				GAS (BBOE) Effective Date of Assessment			
	1/1/81	1/1/85	1/1/90	1/1/93	1/1/81	1/1/85	1/1/90	1/1/93
1. Cumulative Production	445	524	629	699	-	196	266	292
2. Identified (Discovered) Reserves	724	795	1053	1103	-	651	750	856
3. Undiscovered Conventional Resources (mode)	550	425	489	471	-	700	736	780
4. Future Resources (mode) (categories 2+3)	1274	1220	1542	1574	-	1351	1486	1636
5. Total Resources (mode) (categories 1+2+3)	1719	1744	2171	2273	-	1547	1752	1928

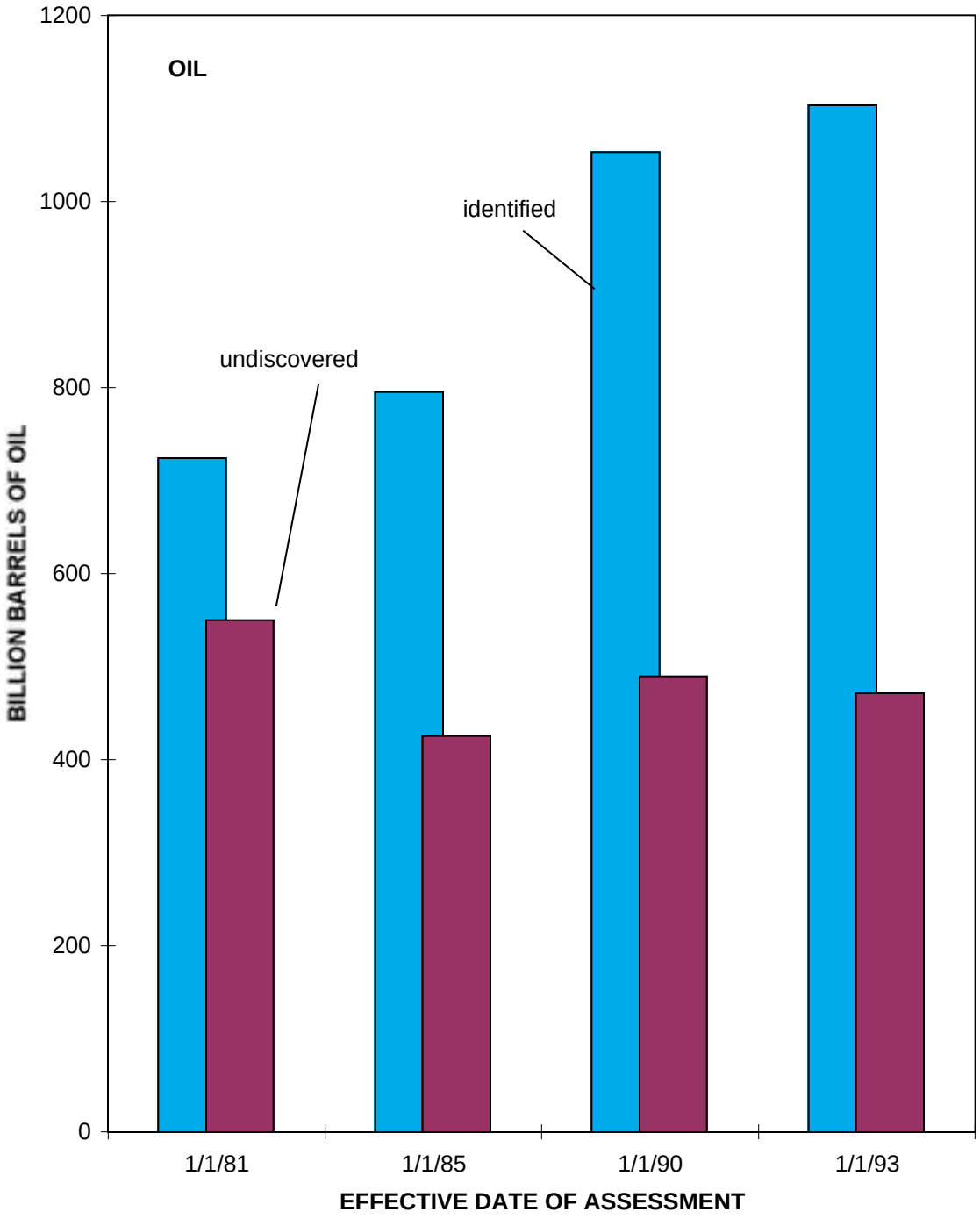

Figure RV-1. Successive USGS estimates of world undiscovered conventional oil resources and identified (discovered) oil reserves. Data are from table RV-1.

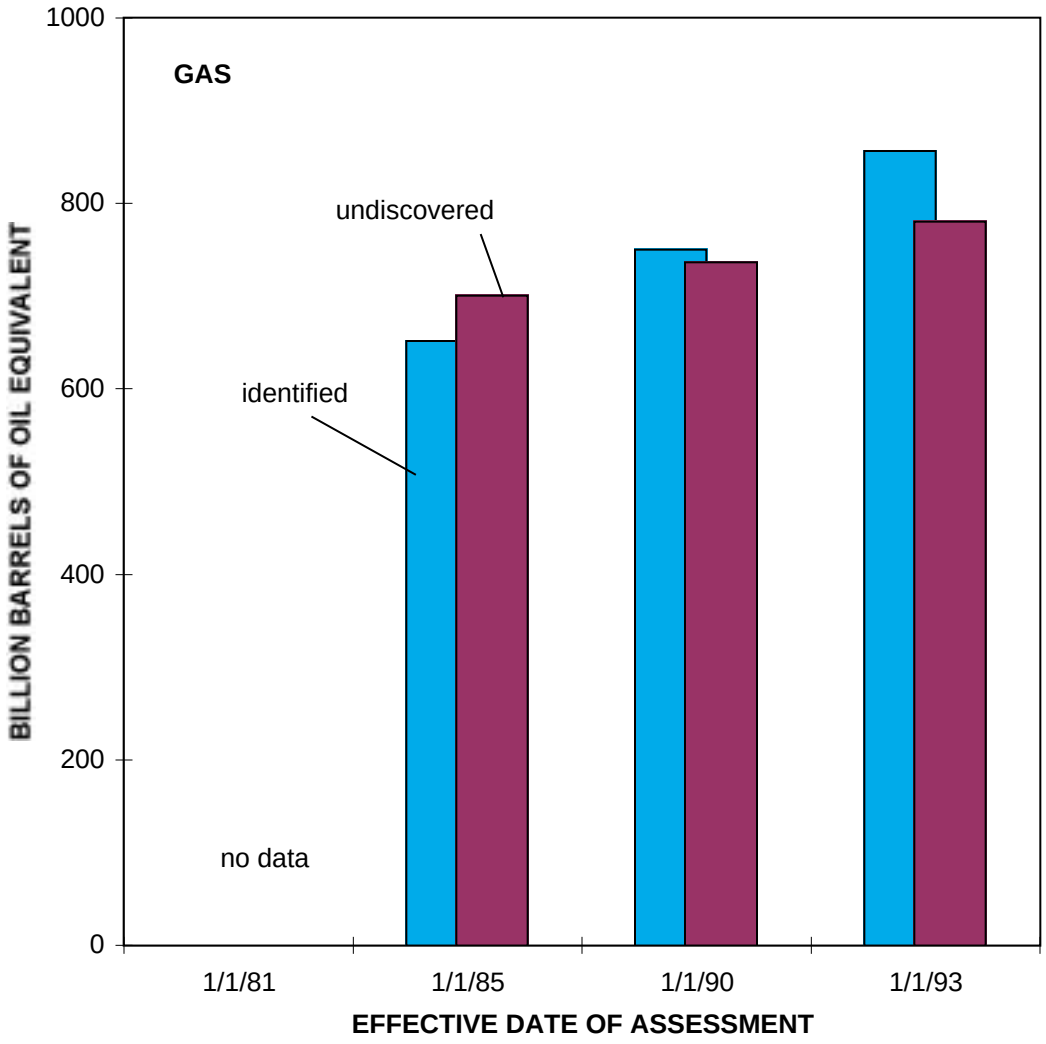

Figure RV-2. Successive USGS estimates of world undiscovered conventional natural-gas resources and identified (discovered) natural-gas reserves. Data are from table RV-1.

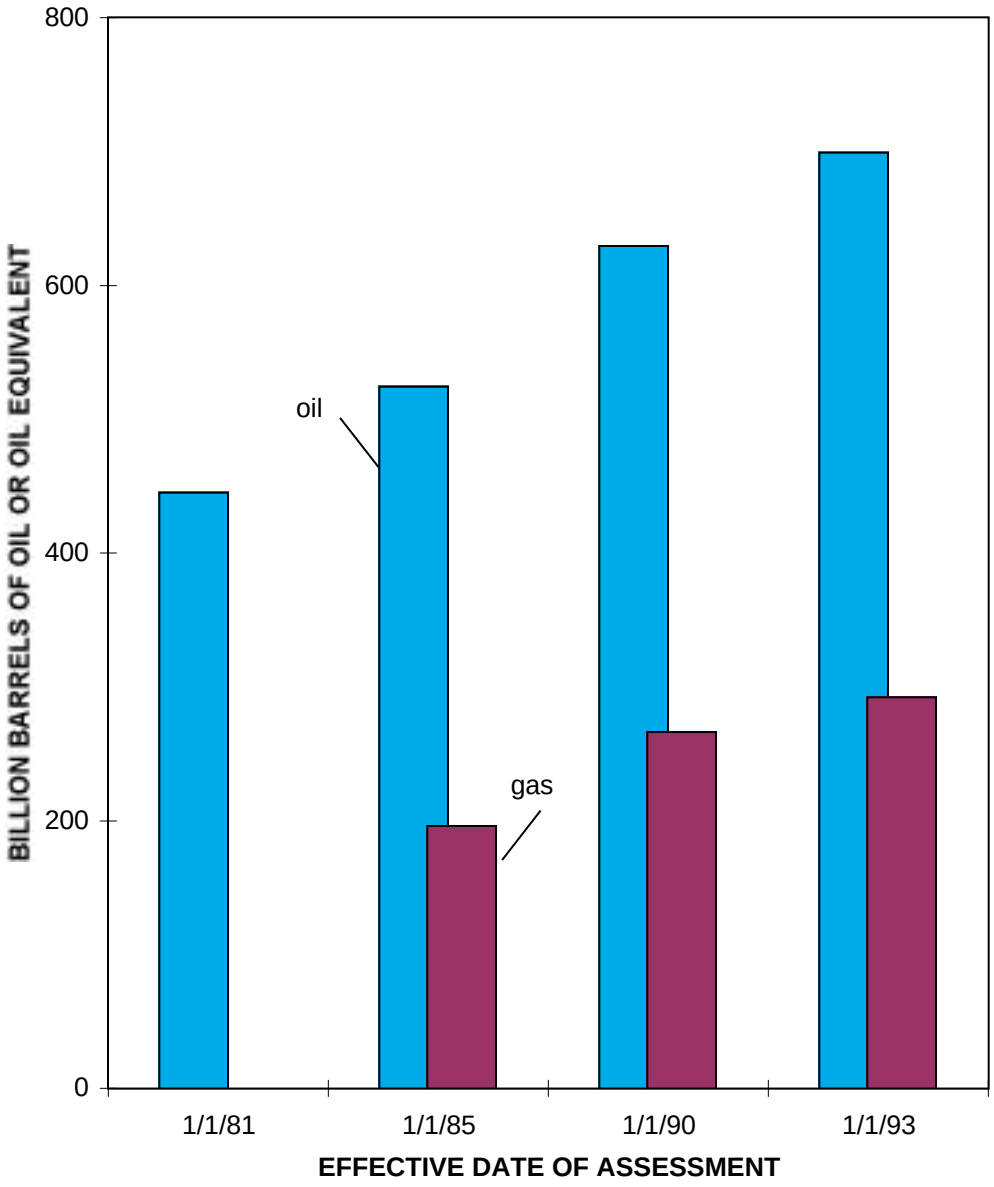

Figure RV-3. Cumulative world production of oil and natural gas. Data are from table RV-1.

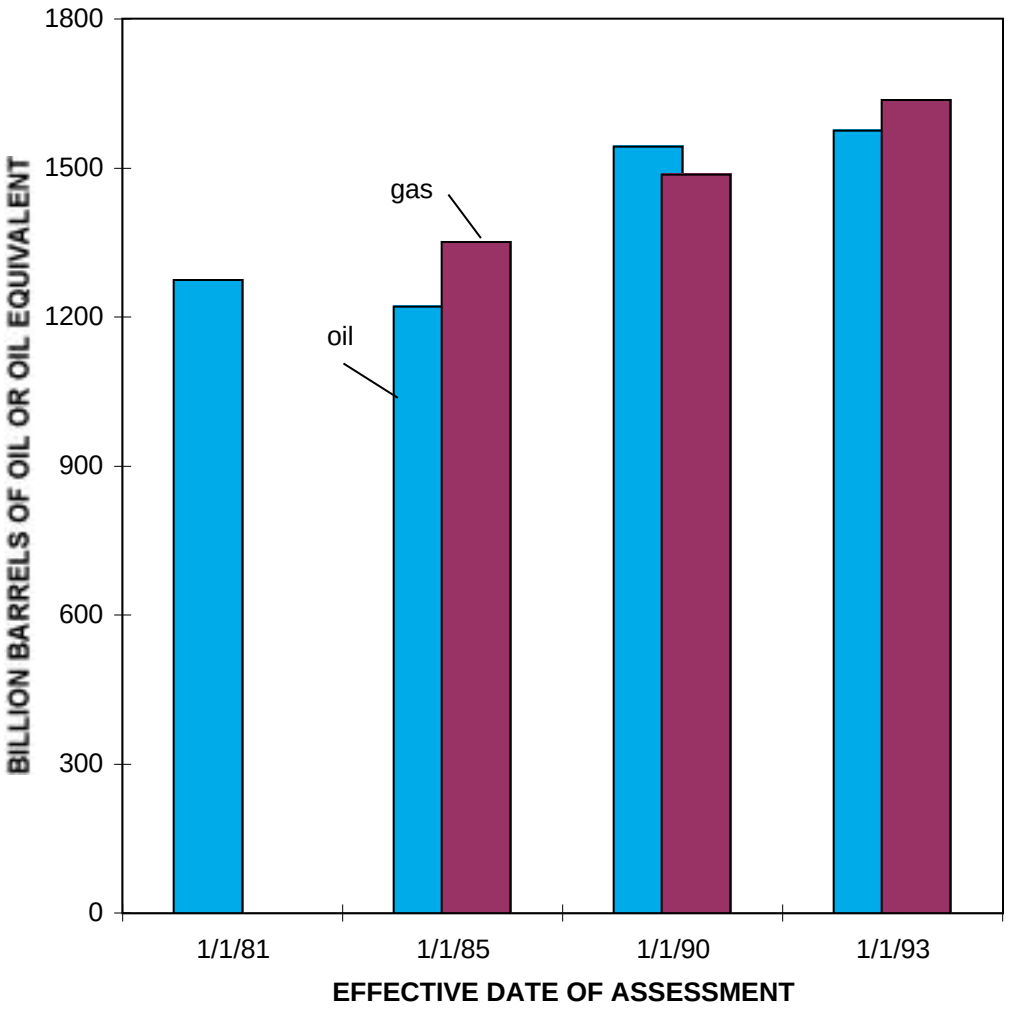

Figure RV-4. Successive USGS estimates of world future resources (identified (discover reserves plus undiscovered resources) for conventional oil and natural gas. Data are from table RV-1.

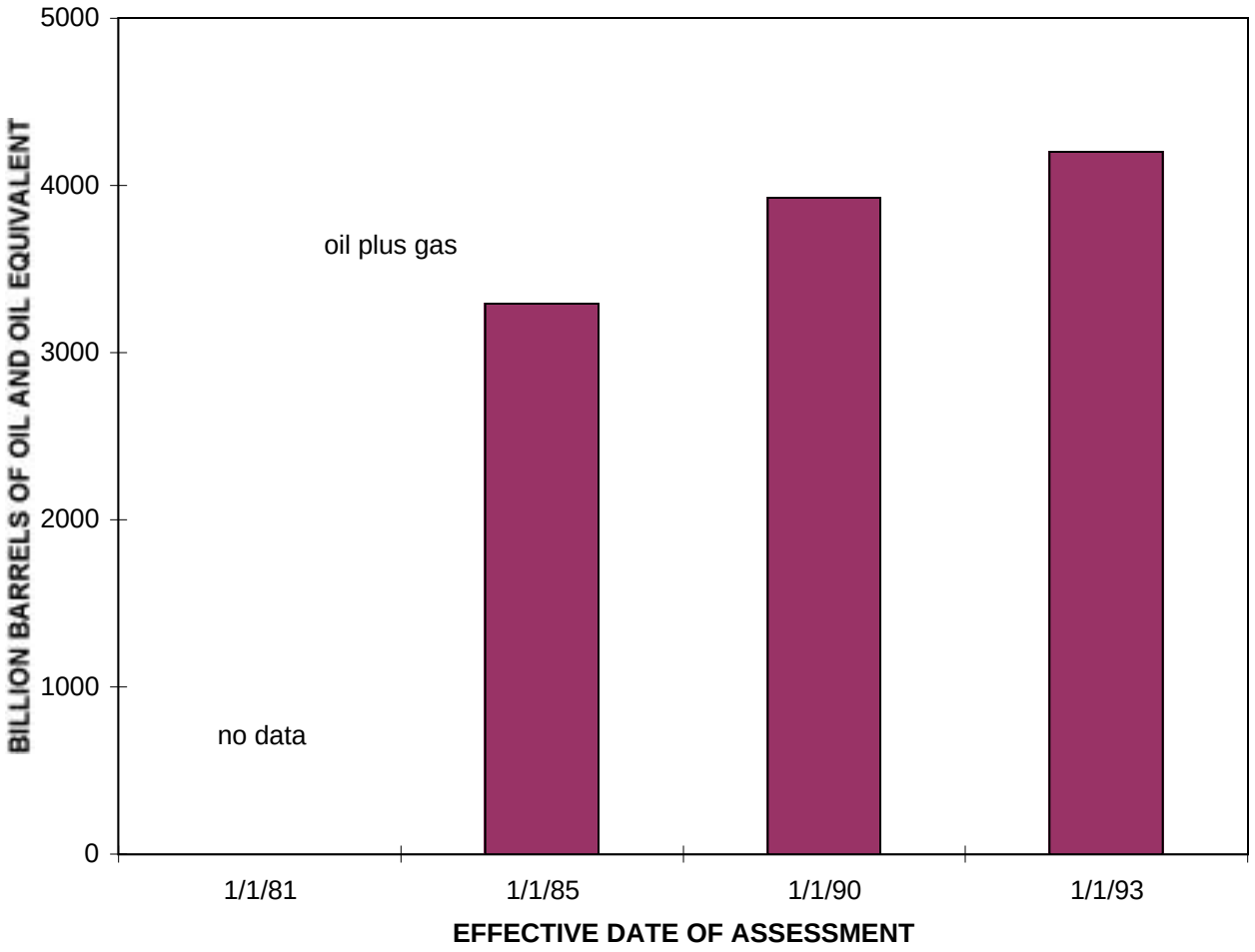

Figure RV-5. Successive USGS estimates of world total resources (cumulative production plus identified (discovered) reserves plus undiscovered resources) for conventional oil plus natural gas. Data are from table RV-1.